Supplementary data

Ultrahigh Electrocatalytic Activity with Trace Amount Platinum Loadings on Free-standing Mesoporous Titanium Nitride Nanotube Arrays for Hydrogen Evolution Reaction

Jiayang Zhao a #, Yan Zeng a #, Jiao Wang a, Qizhi Xu b, Rongsheng Chen a,*, Hongwei Ni a, Gary J. Cheng c,*

a The State Key Laboratory of Refractories and Metallurgy, Institute of Advanced Materials and Nanotechnology, School of Chemistry and Chemical Engineering, Wuhan University of Science and Technology, Wuhan 430081, China
b Department of Chemistry, Columbia University, New York, New York 10027, United States
c School of Industrial Engineering, Purdue University, West Lafayette, IN 47907-2023, United States

* Corresponding authors.
E-mail addresses: chenrs@wust.edu.cn (R.S. Chen), gicheng@purdue.edu (G.J. Cheng)
# These authors contributed equally to this work.
Figure S1

SEM images of the top-surface and cross-section (inset) morphology of TiN NTAs annealed in a tube furnace at 750 °C in NH₃ flow for 1 h (A) and 6 h (B).
Figure S2

Polarization curves of electrodeposition of Pt species with successive 250 cycles on TiN NTAs treated in NH$_3$ flow for 1 h, 3 h and 6 h. The curves were recorded at a scan rate of 1 mV/s in 0.5 M H$_2$SO$_4$ at room temperature.
Figure S3

SEM images of the top-surface morphology of Pt-C/TiO$_2$ NTAs (A) and Pt-TiO$_2$ NTAs (B). Insets show cross-section morphology of the materials.
Figure S4

XRD patterns of TiN NTAs annealed in a tube furnace at 750 °C in NH$_3$ flow for 1 h, 3 h and 6 h, where R means rutile.
Figure S5

(A) TEM image of multiple nanotubes of Pt-TiN NTAs and corresponding platinum element mapping image (B). The boxes refer to the platinum particles.
Polarization curves of Pt-TiN NTAs with different numbers of electrochemical cycles. The curves were recorded at a scan rate of 1 mV/s in 0.5 M H₂SO₄ at room temperature.
CV curves of TiO$_2$ NTAs (A), Pt-C/TiO$_2$ NTAs (B), TiN NTAs (C) and Pt-TiN NTAs (D) at varying rates from 20 to 200 mV s$^{-1}$ in 0.5 M H$_2$SO$_4$ solution. Insets in the four figures show the linear relationship of the current density variation and scan rates.